Green Infrastructure

Report to the Royal Commission on Environmental Pollution

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1. Introduction

The general pattern of urban development in the UK shows a great deal of consistency in terms of its broad environmental characteristics. Heavily built-up central areas, surrounded by suburban residential or industrial development, are superimposed on a pre-existing natural landscape, often influenced strongly by local geology and geomorphological conditions. Within the built environment there is a patchwork of green spaces, some of which have their origins in the original landscape whilst others are part of urban development. In most towns and cities the density of the built environment is greatest in the centre, with a relatively small proportion of open space, much of which is paved rather than green space. The amount of green space increases towards the periphery of the urban area and forms a significant proportion of the landscape in many towns and cities.

Open spaces which have their origins in the pre-existing landscape tend to be more natural in character and include a wide variety of features more commonly associated with rural areas. These may include river valleys and woodlands, or patches of heath, or downland, and even fragments of farmland caught up within the urban environment. Some habitats may still have strong semi-natural affinities, but, as urban development has intensified, so many of these vestiges of more natural conditions have become strongly modified. Rivers and streams tend to be canalised and many have been culverted.

Heaths and commons that survive have generally become more uniform expanses of urban parkland, providing public open spaces within the city environment.

Alongside these are open spaces created as a direct result of urban development. These include town parks, sports fields, golf courses and other recreation areas, graveyards and cemeteries, city squares and street trees, private gardens and allotments. In the urban fringe of many larger towns and cities are extensive country parks and in some cases community forests.

Most towns and cities also exhibit a range of green areas which, although they have developed unintentionally, form a significant resource as unofficial green space of value to local communities, and which may have considerable value for biodiversity conservation. These include habitats developed on urban wasteland and areas of industrial dereliction, also secondary woodlands, and other wild areas developed unintentionally on unused land as, for example, alongside railways and canals. Such areas have been referred to as urban commons (Gilbert, 1992), or unofficial countryside (Mabey 1973). They may also be classified as brownfield land.

This whole range of conditions from the vestiges of long established habitats, and unofficial wild land, through to formal gardens, town squares and tree-lined streets forms the green infrastructure of urban areas. Open land along river corridors and transport routes tends to form linear green networks which provide important linkages, whilst other elements form a less regular patchwork of green spaces. In many towns and cities the total amount of greenspace is very considerable. Two thirds of Greater London is green space or water and only one third is covered by buildings, and hard surfaces such as roads and car parks. Private gardens cover nearly a fifth of the land area and extensive tracts of woodland, heath and downland occur in the outer boroughs (Mayor of London, 2002).

Local climatic and hydrological conditions are strongly influenced by the character of urban areas. The hard surfaces of buildings, roads, car parks, and other solid structures can strongly modify these conditions. The larger the urban area the more pronounced will be its effects on local climate, in particular by promoting an urban heat-island effect. Similarly there are pronounced effects on hydrological conditions through reduced infiltration and more rapid run-off, leading to increased intensity of spate conditions on urban watercourses. Air quality is also influenced to a considerable degree by the scale of urban development. Heavily built-up areas with high traffic densities within larger cities frequently exceed the EU and UK Government's health-based targets for levels of NO_2 and PM_{10}.

In ecological terms, therefore, an urban area can be considered according to its underlying physiographic characteristics, the ecological elements of green space and the interacting variables of climate and hydrology. In reviewing research needs in the urban environment the Natural Environment Research Council has recognised that these large-scale patterns not only provide the basis for describing the range of ecological conditions of urban areas, but also help to determine the range of ecological tolerances and potential

that exists. They provide a framework within which patterns and processes of urban ecology can be better understood and so provide an ecological basis for improved urban planning, design and management (NERC, 1994).

Ecosystem functions

There is general agreement that the ecosystem functions of a green infrastructure can provide a range of benefits which will help to maintain more sustainable conditions in the urban environment. These include provision of sustainable drainage systems and enhanced flood alleviation, local climatic amelioration, improved air quality, providing conditions for urban biodiversity, provision of green space for pubic uses, and associated health benefits.

There are a number of levels at which a green infrastructure can be used in urban design and planning, which are summarised well by the TCPA in its design guide for biodiversity (TCPA, 2004): -

Existing greenspace infrastructure

- Regional parks, green grids and community forests
- Greenway linkages including both woodlands and wetlands
- Parks, and natural green spaces

Green infrastructure within the built environment

- Street trees
- Communal and neighbourhood greenspace
- Green roofs and the built environment

New urban developments

- Newly created green infrastructure as part of new urban developments, including greenway linkages and sustainable urban drainage systems.

The first category provides an ecological framework for spatial planning from the large scale to more local provision of greenspace. This takes advantage of the benefits of the existing greenspace infrastructure of towns and cities and also offers opportunities for its enhancement through creation of new elements at varying scales from community forests and extensive green grids, to local parks and nature areas. Examples of cities which have adopted policies for protection of the green infrastructure at regional scale for spatial planning include Glasgow (Glasgow and Clyde Valley Structure Plan), and London (Mayor of London, 2002). In London the green infrastructure is being used as the basis for strategies for adaptation to counter the effects of climate change in revisions to the London Plan. Since 1994 Berlin has adopted a broad Biotope Strategy for city-wide planning, with the primary objective of using the green infrastructure to deliver ecological services (TCPA, 2004). The different climatic zones within the city have been mapped, illustrating variations in average air temperature, humidity and soil moisture. Five broad zones have been identified which reflect the moderating influences of greenspace.

The second category includes a number of smaller-scale elements of urban design providing opportunities for using the green infrastructure within existing urban areas, and the third is concerned with provision of green infrastructures as an integral part of new urban developments. Examples of the latter vary in scale from individual developments such as the Greenwich Peninsula in London, or the Southern Development Plan in Swindon, to the whole of the Thames Gateway development area.

Understanding the environmental functions of the green infrastructure is particularly relevant to assessing climate change impacts in urban areas and developing adaptation strategies. All the predictive models for climate change in the UK agree that summers will become increasingly warmer and drier, and that winters will be warmer and wetter. In addition it is predicted that there will be increased frequency of more extreme events, such as periods with excessively high summer temperatures, or intense storms with high levels of precipitation, particularly in winter. (DOE 1996, Hulme et.al. 2002). Such conditions are likely to exacerbate environmental problems in urban areas, but there are advantages to be gained from maintenance of an effective green space network, which can help to ameliorate some of these effects.

2. Multifunctional green space

It has been convenient for planning purposes to compartmentalise areas of urban green space according to their primary functions such as parks and other amenity areas, nature reserves, river and canal corridors, and more extensive tracts of metropolitan open land or green belt. Alongside these are areas of derelict or contaminated land, much of which falls within the category of brownfield land. Each has its own set of criteria for planning purposes and there has in the past been little attempt to find a unifying approach by which the benefits of greenspace could be considered in a more holistic way. However, the advent of more sustainable approaches to urban planning and design has provided opportunities to consider the whole range of greenspace in a more unified way, particularly in terms of ecosystem functions.

English Nature outlined the multiple benefits and uses of green networks in a research report by Barker in 1997 which stimulated new approaches to greenspace planning. It was recognised that a range of functions could be accommodated in green networks including river and wildlife corridors, together with local cycle and walking routes and extensive areas of amenity greenspace. Such networks could benefit biodiversity by connecting locally important wildlife sites and provide greater opportunities for people to have access to natural areas in the urban environment. The potential health benefits of urban green space were recognised as being part of an integrated package.

English Nature also encouraged the development of standards for accessible natural green space in towns and cities (Harrison et al 1995, Handley, 2003) which has placed considerable emphasis on the values to be gained from such areas in terms of health and wellbeing.

The Government's Urban Greenspaces Taskforce report in 2002 analysed the reasons for declining standards in greenspace management and recommended that a new national agency be established to set standards and champion excellence in the design and management of urban parks, streets and squares, and to provide guidance at national and local level. Cabe Space, which is part of the Commission for Architecture and the Built Environment, was set up in 2003 to undertake this role in England and has already had considerable influence through its advice, publications and award schemes. Cabe Space has argued strongly that high quality parks and public spaces are of value in economic, social and environmental terms (Cabe Space, 2004) and is concerned with the full spectrum of green open space in towns and cities. Early priorities were to provide guidance for the production of park and green space management plans and a review of the skills shortages in parks (Cabe Space, 2004a, 2000b). It is, however, also concerned with more natural areas and is currently producing guidance for management of biodiversity in urban open spaces. Cabe Space also recognises that health benefits are a key element in the social value of greenspace.

There are parallels here with the work of Greenspace Scotland which addresses many of the same issues. However, there are important differences in that Greenspace Scotland has a rather broader remit, and has stronger links with urban economic development,

health, and social justice. Greenspace Scotland sees urban greenspace as having a crucial role to play in key elements of sustainable development, including transport, enterprise and lifelong learning, environmental quality, health, and social justice, which go well beyond traditional approaches to greenspace management. Its strategy, set out in *Making the links: Greenspace and the partnership agreement* (2004) is jointly sponsored by the Scottish Centre for Regeneration, the Scottish NHS (Health Scotland) and Scottish Natural Heritage. Greenspace Scotland has succeeded in developing an integrated approach to greenspace management rarely seen at national level, because it involves, and is supported by, a wide range of government departments. The philosophy of "Making the Links" uses all the facets of the green infrastructure to develop effective policies for urban renewal and to provide clear environmental and social benefits. The strong emphasis on health issues, and direct involvement of Health Scotland is particularly striking. The approach could form a good basis for Government Guidance on best practice in relation to the Green Infrastructure elsewhere in the UK.

There is currently a tension in planning between the Government's guidance in relation to provision of open space (PPS17) which identifies a wide range of categories including sites of nature conservation value, and the strong recommendations for sustainable development, with pressure to maximise the use of brownfield land for housing in PPG3. Together with the trend for local authorities to dispose of open land to avoid the costs of management, there are currently a number of conflicting aims. Whilst pressure for new housing has dominated the strategic planning agenda, consideration of the necessary environmental infrastructure has been virtually ignored. This is despite the growing awareness of the value of open spaces, not only for public enjoyment and nature conservation, but also for provision of ecological services and health. The major agencies, (including the Environment Agency, Scottish Environmental Protection Agency, English Nature, Cabe Space and English Heritage) are all involved in different aspects of policy relating to the Green Infrastructure. Each has its particular agenda but there is a case for development of a more unified policy framework for urban greenspace as a crucial element of urban planning and development.

It is suggested that Government Guidance akin to PPS 17 be produced to emphasise the benefits of the green infrastructure, particularly in terms of the ecological services which it provides, and to demonstrate best practice for urban design and planning. This is set out in more detail in Section 9. The TCPA design guide *Biodiversity by Design* provides many of the elements which would need to be included in such guidance (TCPA, 2004). Evidence to the Commission from several sources suggested that this design guide should be adopted by Government and referred to in planning guidance.

3. River management and sustainable urban drainage systems.

Under natural conditions rivers are dynamic systems continually moving and interacting within their floodplain. Where urban development has occurred within the flood plain rivers have generally been heavily modified to allow maximum land take and to provide the subsequent flood protection required by these new urban developments. In most urban areas in the UK the solution has been to straighten the river channel and contain it by canalisation or culverting. However, river management within urban areas presents considerable challenges not only because of the loss of flood plains. The high proportion of sealed surfaces in heavily built-up urban areas causes more rapid and increased volume of run-off, and higher peak flows than in less urbanised environments. Urban peak flows frequently overload drainage systems causing flash flooding and may cause foul sewers to overflow. Urban run-off also carries a range of pollutants from the surfaces of buildings and streets into watercourses reducing river water quality.

In recent years it has been recognised that environmental improvements along urban river corridors can have both environmental and social benefits and more sustainable approaches to the management of urban watercourses are now being promoted by national agencies (SEPA and EA) and by local authorities. These include river restoration schemes and Sustainable Urban Drainage Systems (SUDS).

3.1 River restoration schemes

The Environment Agency is undertaking a number of programmes of river restoration in urban areas, of which the south London project is a notable example (Environment Agency, 2002). Priority was given to restoration of sections of rivers within public open spaces by converting concrete lined channels to more natural conditions and in one case restoring a river which had been put underground across a park. In a series of four case-studies the Environment Agency has demonstrated considerable environmental and social benefits achieved by these schemes.

Environmental benefits include:

- Creation of sustainable in-stream, marginal, wetland and floodplain habitats
- Significantly increased biodiversity
- Increased flood storage capacity
- Creation of a natural river corridor reconnecting natural stretches of river and facilitating movement of wetland species
- Provision of reedbeds for natural treatment of pollutants
- Creation of new wetland habitats within the river corridor.

Social benefits include:

- Creation of more attractive, diverse and accessible public open space
- Improved natural environments close to urban centres.

- Improved visual appearance of the river corridor
- Provision of an attractive, accessible and safe river environment within urban areas
- Value to local schools for environmental education
- Provision of open space for a wider spectrum of local the community

The Environment Agency has undertaken an assessment of public attitudes and use of Sutcliffe Park, Greenwich following restoration, which strongly supports these social benefits. Before restoration, Sutcliffe Park was a flat green area, lacking biodiversity, with the River Quaggy running in an underground culvert. Restoration of the river for flood management and re-landscaping work was completed in June 2004, and the park now has a more varied environment with more natural habitats. Before the improvements, most people (42%) came to walk dogs. Following improvements the number of park visits increased by 73% and most visits were for exercise, increasing from 40% to 68%. The survey showed that people are more than twice as likely to visit for 'health' reasons (66% compared to 25% previously) such as fresh air or walking (see Environment Agency Case Study, Sutcliffe Park Greenwich).

There are good examples in Germany of restoration of urban waterways to more sustainable conditions, such as the Emscher Park project in the Ruhr industrial region which pioneered the de-culverting of urban waterways, together with creation of new wetlands and buffer strips of ecologically functional flood meadows and woodlands. Other notable examples include the restoration of the Don Valley in Toronto (City of Toronto, 1991) which provides cogent arguments on the values to the local community. An extensive programme for restoration of urban streams, and rivers was developed in Portland Oregon led by the Urban Streams Council, an NGO working with watershed managers and the Metropolitan Planning Agency. The technical, political and ecological aspects of urban stream restoration in US cities are well described by Riley (1998).

In the UK the South London programme is only one amongst many local schemes for rehabilitation of urban rivers. The Mersey Basin Campaign is another successful initiative which has resulted in environmental and social benefits within a large urban catchment. However, there is no overall national programme promoting such schemes, and it is suggested that detailed guidance on river restoration within urban areas, including costs, benefits and sources of funding would be a valuable component of future Government Guidance on the Green Infrastructure.

3.2 Sustainable urban drainage systems.

Sustainable drainage systems (SUDS) have been widely accepted as part of new urban developments and redeveloped sites for many years in some European countries, particularly in Sweden, Germany, Switzerland and the Netherlands. They are now being actively promoted in the UK by central Government, and in particular through the Environment Agency and Scottish Environment Protection Agency together with the construction industry through CIRIA (see SEPA/EA 1997, CIRIA 2000, 2001). The aim

of the SUDS approach to urban drainage design is to mimic as closely as possible the natural drainage from an area before development and to treat run-off to remove pollutants. This approach aims to balance the benefits of drainage in terms of water quantity and quality, and for enhancing amenity, using a range of techniques, such as permeable surfaces for car parks and roads, together with ponds and wetlands to absorb and moderate the run-off. Such systems slow the rate of run-off, reduce the total volume of run-off from new development sites, and provide opportunities for rainwater capture and re-use. They provide more natural approaches to urban drainage and help to prevent both flooding and water pollution. They can also be designed to provide new wildlife habitats and attractive features within the urban environment.

Elements of their design include:-

- green roofs and rainwater harvesting systems
- permeable instead of sealed surfaces
- grassed swales to convey surface water run-off
- treatment basins, including ponds and wetlands that receive run-off from the development prior to discharge to a watercourses
- creation of additional wetland features of value for biodiversity and amenity

An example from Germany is illustrated by the TCPA in its design guide for biodiversity. Kirchsteigfeld is a 60 ha high-density urban extension of Potsdam with over 2,600 new homes. The masterplan requires surface water to be dealt with by means of a sustainable drainage system. The system starts with water draining from courtyards into swales where it either soaks away, evaporates, or may be retained. It then flows along verges into minor streets before being collected into a stream forming part of a formal linear park. From there it flows into a retention and treatment basin before draining into the surrounding rural area (TCPA 2004).

It is generally accepted that implementation of the SUDS approach as opposed to conventional drainage systems has several benefits including:

- reducing peak flows to watercourses or sewers and reducing the risk of flooding downstream
- reducing volumes and the frequency of water flowing directly to watercourses from development sites
- improving water quality over conventional surface water drainage by removing pollutants from diffuse pollutant sources
- reducing potable water demand through rainwater harvesting
- improving amenity through provision of new areas of public greenspace and wildlife habitat
- replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained

Current position of SUDS in the UK

Although some elements of SUDS, such as permeable surfaces for car parks, have been used for some time in the UK, it is only relatively recently that the concept has gained general acceptance for use in major urban development schemes. Case Studies provided by CIRIA include the Bristol Business Park, and the much larger Dunfermline Eastern Extension. It is argued that the Dunfermline scheme could not be developed without the benefits of a sustainable drainage system, because of the constraints imposed by local drainage conditions. Another example where sustainable drainage systems are integral to a new urban development is the Swindon Southern Development Plan.

Legislation affecting urban drainage in the UK is complex, and since sustainable drainage techniques were not widely practiced in the UK at the time when primary legislation was passed, this approach to drainage is not dealt with explicitly. However, Government guidance on Development and Flood Risk (PPG 25) recommends the use of sustainable drainage systems (SUDS) as a way of reducing problems associated with rapid run-off and higher peak flows in urban areas, and refers to CIRIA guidance on SUDS for further details (eg CIRIA 2000, 2001). This guidance is currently being revised and the consultation draft contains stronger policies on the use of sustainable drainage systems.

The Government has established a National SUDS Working Group to address possible barriers impeding more widespread use of SUDS in England and Wales. In 2003 the Group published a Framework, which was intended to provide a set of core standards and agreements between key public bodies with statutory or regulatory responsibilities relating to SUDS. It was designed to provide support for developers in promoting and implementing SUDS, to ensure their long-term viability and to promote consistent use. Following public consultation it was evident that there was no clear consensus on who should be responsible for SUDS maintenance and adoption but that there was a clear wish that this should be as simple as possible. Given the urgent need to simplify the use of the SUDS approach to drainage within the current regulatory system, the Working Group produced an Interim Code of Practice for SUDS, based on the draft Framework and taking into account the comments received during the consultation (ODPM 2004).

The specific objectives of the interim code are to:

- encourage the implementation of SUDS in new and existing developments
- provide basic guidance for practitioners on the implementation of SUDS in new developments
- make the adoption of and allocation of maintenance for SUDS more straightforward.

Surface water management is also addressed in the recent ODPM Proposals for introducing a Code for Sustainable Homes (ODPM 2005a). The proposed minimum standard (Code Threshold) is intended to ensure that peak run-off rates and annual volumes of run-off will be no worse than the original conditions for the development site. This threshold is a desirable objective as a minimum standard which could well be challenging in the case of many greenfield sites. However, in the case of some

brownfield sites it might well be unacceptable to simply achieve existing conditions, owing to the present extent of hard surfaces, and this needs to be recognised. In examining costs and benefits the ODPM states that studies carried out in comparing SUDS with traditional pipe drainage and underground storage indicate that SUDS are generally no more expensive and that issues of land take and compliance with other policies (PPG3 Housing) influences drainage design more than the issue of cost. ODPM also recognises that there can be significant costs to society resulting from flooding, and this needs to be taken into account in examining the long-term costs and benefits of implementing SUDS as an integral part of urban development.

Substantial progress has therefore been made in promoting greater awareness of the role that SUDS can play, particularly within new urban developments. There is now clear guidance from government encouraging such an approach. A considerable amount of research on sustainable drainage is in hand in the UK and knowledge of the design of SUDS and their long-term effectiveness is improving. However, despite this it seems that such schemes are still far from being the norm in new urban developments.

Whilst there is much talk of making SUDS normal everyday business the reality is that many water companies make it difficult for developers to put in a proper SUDS system either because they cannot adopt some elements of the SUDS drainage scheme or because they still insist on surface water sewers being provided in addition to the SUDS. There is a long-established working practice in the water industry which sees pipe-drainage as the best solution and regards SUDS as inherently risky. The result is that most new urban development schemes are still being built with traditional surface water drainage. One of the factors in this is the requirement in Section 106 of the Water Industries Act 1991 which gives the property owner a right of connection to a public sewer irrespective of the suitability of alternative drainage systems. This legislation needs amendment to allow greater flexibility in new schemes. A further problem for developers is that it is frequently the case that none of the agencies involved will adopt a SUDS drainage system in its entirety. As a result developers have to negotiate with local authorities and the water company, often leading to delays which result in the developer opting for the simple pipe-drainage solution. Whilst the Interim Code of Practice goes some way towards making the adoption and allocation of maintenance for SUDS more straightforward, there is a need for clear advice from Government to Local Authorities and Water Companies to resolve this problem.

Linked to this is the need for central government to be more forceful in advocating the use of SUDS. The recent consultation draft proposing revised guidance on Development and Flood Risk (PPS 25) goes some way to strengthen arguments for the use of SUDS. It proposes that “those responsible for development are responsible for designs which reduce flood risk to the development and elsewhere, by incorporating sustainable drainage systems”. Annex F describes the range of approaches within SUDS and states that “Regional planning bodies and local authorities should promote the use of SUDS for the management of run-off”. Such guidance will help but the government could go further by placing a duty on relevant public bodies and developers to implement sustainable drainage systems in preference to traditional pipe drainage schemes.

The Commission should urge the Government, Local Authorities and Water Companies to be more proactive in promoting the use of SUDS and finding solutions to current barriers, especially the problems of adoption, long-term maintenance and responsibilities in relation to flood-risk. The Interim Code of Practice was drawn up as a means of making progress within the current statutory framework. In view of the scale of the problem urgent consideration needs to be given to possible legislative changes to make one specific sector responsible, either Local Authorities or Water Companies. In the absence of this, more specific Government guidance will be essential to clarify responsibilities in this field.

Whilst the Interim Code of Practice for Sustainable Drainage (ODPM, 2004) recognises that SUDS can be useful in contributing to nature conservation targets, there seems to be little appreciation at national level of the considerable opportunities for a range of broader social benefits to be achieved through the associated greenspace networks.

On the other hand at the local level there are good examples of schemes which attempt to integrate SUDS within a multipurpose greenspace network. The Swindon Southern Development Area is one such example. Such schemes need to be promoted, not only in relation to good practice for SUDS, but also as a basis for more integrated use of greenspace networks. It is suggested that examples of this kind be included in Government Planning Guidance for the Green Infrastructure.

Given the technical problems of implementing all elements of SUDS in existing urban developments (due to lack of space for swales and watercourses etc) it is surprising that current government guidance makes virtually no mention of the considerable potential offered by green roofs. Reference to Green Roofs should be included in any revision of the Interim Code of Practice for SUDS, and should be included in future planning guidance for the Green Infrastructure.

In view of the increasing urgency to put in place adaptation measures in response to climate change, with regard to both provision of water resources and to reduce flooding in urban areas, there are powerful arguments for the effective implementation of SUDS to be given much higher priority by both national and local government. A target should be set to ensure that all new urban drainage schemes should be based on the SUDS approach within ten years.

4. Climatic amelioration

It is well established that towns and cities tend to experience higher temperatures than surrounding rural areas due to the heat island effect. City centres may be up to 7^{o}C higher than the surrounding countryside, and the larger the city the more intense is the heat island effect. This is caused by a variety of factors including:

- low albedo of streets and buildings resulting in greater absorption of heat from the sun
- solar heat stored in the urban fabric released at night
- heat released from fuel combustion for transport, heating and cooling
- reduced evaporative cooling from vegetation
- streets and buildings tending to trap radiation

Studies have indicated that increasing tree cover by 25% can reduce afternoon air temperatures by between 6 to 10^{o}C, and simulations of a 30% vegetation cover reduced temperatures by as much as 6^{o}C. Others have shown that vegetation in streets can reduce temperatures by 2^{o} C. Comparisons of temperatures in city parks and surrounding urban areas in Japan have demonstrated differences of 2.5 to 4^{o} C. (Kanda et.al.1991, Asaeda, et.al.1998). Vegetation provides cooling through evapo-transpiration and which also adds humidity to what is frequently uncomfortably dry city air.

Increased urban temperatures are part of the cause of photochemical smog. Data from the US suggests that for every 3^{o} C increase in temperature there is a 10% increase in polluted days (Akbari et al, 1992).

The value of green open spaces within cities for ameliorating local climatic conditions is widely appreciated, and is frequently quoted as one of the beneficial functions of greenspace. The Berlin Biotope Strategy has taken this further than most cities by recognising five broad climatic zones within the city which are characterised by variations in air temperature, humidity and soil water, and which reflect the moderating influence of greenspace.

At the local level the importance of street trees in ameliorating the local climate of urban areas needs to be more fully appreciated, and their value for shading buildings more fully understood, particularly in relation to future climate change. Handley, in evidence to the Commission, has outlined ways in which research on these issues can assist in reducing the effects of climate change in UK towns and cities.

<u>Recommendation</u>

The Commission should urge the Government to produce detailed guidance with case-histories to demonstrate the value of green spaces, and street trees, for climatic amelioration in urban areas.

5. Green Roofs

5.1 Background

Green roofs can provide environmental benefits of a green infrastructure in the heart of the built environment. In some parts of Europe, especially Germany, Denmark and the Netherlands their use has become widespread and their benefits well tested. It has been demonstrated that green roofs make buildings more thermally efficient, prolong the life of the roof, ameliorate extremes of temperature and humidity, moderate surface water run-off and help to reduce air and noise pollution. They also provide opportunities for wildlife in heavily built up areas and can provide space for habitats of special urban character to be maintained. Green roofs have the potential to play a significant part in achieving more sustainable conditions and improving the quality of urban life.

Germany has long recognised the benefits and has led the way in the development of green roofs through new technologies and by imposing legislation requiring green roofs for particular types of development. In 1989 the total amount of green roofs installed was about 1 million m^2, rising to 11 million by 1997 and to 13.5 million by 2001. The technology is well established and such roofs are now a part of normal practice in urban development including both industrial and residential developments.

By contrast, in the UK, such roofs tend to be something of a novelty, and those that have been established are largely for showcase buildings or environmental centres, perhaps giving the impression that they are not appropriate for mainstream urban development. However, there has been a growing awareness of the potential benefits of green roofs within the development industry in recent years, largely in response to detailed guidance from English Nature (2003).

5.2 Benefits of Green Roofs

The range of benefits was first set out in detail in *Building Green* (Johnston and Newton, 1993), in which four main categories of benefits were identified as amenity, ecological, technical and financial. These included the following:-

Amenity

- improved visual amenity
- psychological benefits
- provision of roof-top gardens

Ecological

- slowing and reduction of storm-water run-off
- reduction of urban heat-island effect
- provision of wildlife habitats
- improved provision of green space in densily built-up areas
- reducing air pollution

Technical

- protection of roof surface (particularly from ultra-violet damage)

- thermal insulation
- acoustic insulation

Financial

- reduced long-term maintenance costs

One of the main benefits of green roofs is in water retention and reduced run-off. The report by English Nature provides useful figures which show that up to 75% of rain falling on extensive green roofs can be retained in the short term and as much as 15-20% of this can be retained for up to 2 months. Rates of water retention vary from 58% to 71% depending on the depth of green roof. (A 25mm deep moss and sedum layer over a 50mm deep gravel bed retains about 58% of rainfall and a 100mm turf layer retains about 71%). Some examples can be even more effective in terms of immediate retention. In one case following a 10mm rainstorm of 200 litres of rainfall on an $18m^2$ extensive roof only 15 litres of runoff reached the ground. Green roofs often form an integral component of SUDS in Germany where attenuation of run-off is considered to be one of the most important benefits of green roofs. Germany has installed over 100,000 water-harvesting systems in recent years, whilst the UK has only 1000 (Butler et al 2005).

English Nature's report also provides details of planning policies in Switzerland and Germany which encourage green roofs. In Switzerland, federal law requires all federal agencies to apply the 'Swiss Landscape Concept' when commissioning or rehabilitating federal buildings and installations. This means that facilities must be compatible with natural settings and landscape. Laws also require that 25% of all new commercial developments are 'greened' in an attempt to maintain microclimates. In Germany 43% of cities offer financial incentives for roof greening. About 30 of the largest cities (including Berlin, Frankfurt, Karlsruhe, Kassel, and Stuttgart) give direct financial support to roof greening ranging from 25 to 100% of the installation costs. The League of Cities in Germany supports the idea, citing the significant saving in heating and air conditioning costs. Indirect aid for green roofs is provided in other ways, for example 17% of German cities offer reduced sewage disposal charges for developments with green roofs. The Federal Nature Conservation Act requires mitigation for the ecological impact of building construction. This means that green roofs are often required by conditions attached to construction permits.

As well as providing increased thermal insulation on buildings it has been found that green roofs have an added advantage where photovoltaics are installed. This is because their efficiency can be reduced by high temperatures of normal roof materials during hot weather, and they work more efficiently on green roofs because of the cooling effect of the vegetation.

5.3 Biodiversity

Green roofs provide considerable opportunities for biodiversity, and are particularly important in heavily built-up urban areas where there is little space otherwise for wildlife habitats. Potential benefits for biodiversity identified by English Nature (2003) include:

- helping to remedy areas of deficiency i.e. providing new habitat in urban areas which are currently lacking wildlife habitat
- creating new links in a network of habitats thereby facilitating movement and dispersal of wildlife.
- Providing additional habitat for rare, protected or otherwise important species.

Green roofs offer special opportunities for creation of those habitats which are particularly characteristic of urban areas, and there has been considerable recent interest in the use of green roofs as mitigation for important ruderal habitats lost during urban regeneration. These include habitats which support protected species such as black redstart (Frith and Gedge, 2000, Wells, 2001). The creation of brown roofs to replicate post-industrial urban habitats, especially in the case of brownfield site redevelopment, is a significant innovation which could have far-reaching implications for future urban development. Examples of such brown roofs are now well established, and their potential for mitigating losses of biodiversity are becoming more widely appreciated within the urban development professions, through examples such as the Deptford Creek development in London.

The web-site Livingroofs.org provides an independent UK resource-base on green roofs with detailed advice on installation, perceived barriers preventing wider implementation, reviews of current research, the current policy framework, and numerous case studies.

5.4 Current policies and practice in the UK

Although the benefits of green roofs are becoming more widely appreciated in the UK they are not referred to in Government planning guidance for biodiversity (PPS 9). In referring to biodiversity within developments PPS9 recognises that development proposals provide many opportunities for building-in beneficial biodiversity features as part of good design. It recommends that local planning authorities should maximise such opportunities in and around developments, using planning obligations where appropriate. However, the guidance does not refer specifically to green roofs. Nor is there any reference to green roofs in the recent ODPM proposals for introducing a code for sustainable homes. Although green roofs can form a valuable component of SUDS, especially in heavily built-up urban areas, their potential is not yet recognised in official UK advice. There is only a passing reference to green roofs in the interim code of practice for sustainable urban drainage (ODPM, 2004)

5.5 Recommendations

The Commission should urge the Government to refer specifically to the benefits of Green Roofs as part of planning guidance in relation to housing, urban drainage and biodiversity, and to provide case studies to promote greater public awareness of these benefits. There should be specific reference to green roofs in planning guidance for the Green Infrastructure.

6. Urban Biodiversity

6.1 Background

Conservation of nature in UK towns and cities has become widely accepted over the past twenty years as part of urban planning and design. It has been recognised that a considerable variety of habitats occur in urban areas and that provision needs to be made for their protection and enhancement, not least because of their value to people who live in towns and cities. These habitats fall into two categories, those which are fragments of the more natural habitats of the wider countryside which have become encapsulated within urban areas, and others which are specifically urban in character, having developed on a range of man-made environments. The first category includes stream and river valleys, ancient woodlands, heaths and commons all of which may be heavily modified by the pressures of their urban surroundings. The second group includes a great variety of habitats of artificial origin including post industrial landscapes of disused and derelict land, mineral workings, railway-sides, disused cemeteries, parks, city squares and private gardens. The range of species is considerable. The patchwork of habitats in urban areas frequently contains a greater variety of species than rural landscapes of equivalent scale. Some of the species concerned have particular value as urban specialists.

However the main emphasis of urban wildlife conservation is with the ordinary rather than the special. The importance of urban habitats and greenspace for providing people with opportunities to enjoy wildlife as part of their daily lives has become increasingly recognised, and there is now a strong emphasis on improving people's access to nature in many urban wildlife strategies and projects. Whilst the protection of important local sites remains a key element of such programmes the importance of promoting awareness of wildlife in domestic gardens or within the built environment is now widely recognised. One of the strengths of urban nature conservation lies in the emphasis on community involvement. Many of the programmes are led by urban wildlife groups with strong community links. In this respect support for nature conservation in urban areas has drawn on a wider social constituency than the science-based approach to key site protection which forms the basis of UK policy for nature conservation.

Another important feature is the emphasis on habitat creation as a crucial component. The creation of new habitats offers particular opportunities within new urban developments, but also has considerable relevance in existing urban areas. The scale may vary from urban fringe community forests, or green networks within new urban developments, to the creation of major new ecological sites and centres (such as the London Wetland Centre), or small ecology parks, and community gardens. Provision of green and brown roofs is also becoming increasingly accepted as a means of enhancing biodiversity within the built environment, and at the same time catering for some of the specialist urban habitats of brownfield sites (see also Section 5 on green roofs). There is, therefore, a strong potential for biodiversity to be accommodated in urban design, within both the existing built environment and in new developments.

Despite considerable progress being made in the development of urban nature conservation over the past twenty years it still tends to be seen as a minority interest in relation to both the national biodiversity strategy, and mainstream urban development. The problem is that that urban biodiversity has three kinds of value:-

- the intrinsic value of specialist urban habitats and species
- the value of biodiversity to people living in urban areas
- the ecological services which it provides.

The existing legislative framework for conservation of biodiversity in the UK was not designed to cater for urban areas and currently caters for none of these values adequately.

In the first case, urban habitats tend to be undervalued as they commonly fall outside the categories of habitat recognised nationally as being of nature conservation importance. The physical characteristics and processes of urban areas frequently result in a range of habitats and species of particular urban character which are not generally found in the countryside. Some are virtually restricted to specialised conditions resulting from post industrial landscapes which are poorly described in UK habitat and vegetation classifications. As a result national policies for biodiversity conservation do not at present give adequate recognition to these specialist urban habitats. A few outstanding examples have achieved SSSI designation, as in the case of invertebrate populations at Canvey Wick in Essex, but these are exceptional cases and there are no clear guidelines for evaluating such habitats. This is addressed further in section 6.2 below.

Although the value of biodiversity for people living in urban areas has become widely appreciated and is now an accepted element of nature conservation policy at national level, this does not sit easily with a national biodiversity strategy which gives priority for protection to habitats and species of international and national importance. Hardly any of the many important biodiversity sites in towns and cities qualify as Sites of Special Scientific Interest in the national context. Protection of important urban habitats requires other criteria to be recognised, reflecting their social and cultural values. This needs to be given greater recognition in planning guidance, otherwise such sites will receive only limited protection in the planning process.

The same argument applies in the case of ecosystem functions and services. Habitats within the urban environment may have significant value in the range of ecological services which they provide, especially in terms of flood alleviation and local climatic amelioration. Whilst the importance of these functions is recognised in government policies for sustainable development, the hierarchy for protection of biodiversity in planning (based on international and national importance) takes precedence, and as a result the planning process does not give sufficient weight to the functional value of urban habitats. So in most towns and cities features such as streams and river valleys which have a vital role in maintaining sustainable urban drainage, may have no designation for protection, or are at best regarded as having only local value in terms of their biodiversity.

There is a clear need for more specific reference to the wider values of urban biodiversity in Government planning guidance, particularly in terms of the social values and ecological functions which it provides. It is suggested that such guidance should form part of a planning policy statement on the green infrastructure.

6.2 The UK Biodiversity Action Plan

The national Biodiversity Action Plan addresses all aspects of biodiversity in the UK including towns and cities. A number of broad habitat types (such as woodland) are recognised and within each type Priority Habitats are identified. Urban habitats have, however, posed something of a problem. Although a broad urban category was recognised, priority habitats have yet to be defined. A review of the habitat and species coverage of the UK BAP is currently underway and has provided an opportunity to assess the coverage of habitats and associated species which can be regarded as characteristically 'urban'. A recent study, commissioned by English Nature (Tucker *et.al*. 2005) concluded, inter alia, that:

- There is a strong case for the separate recognition of a group of habitats under a combined category of "Post-industrial sites of High Ecological Quality" as a Priority Habitat. These habitats are both ecologically valuable and are threatened.
- The majority of urban habitats are of moderate or high overall conservation importance, often in terms of both biodiversity and social value.
- Conservation efforts should not solely focus on Priority Habitats and Priority Species, but should also aim to maintain all remaining semi-natural habitats in urban landscapes and strive to enhance their ecological quality and connectivity.
- The overall number of Priority UKBAP Species associated with urban habitats has been previously underestimated

The report also recognised the need for further research regarding urban habitats and species and recommended specific habitat types which need to be addressed. The UK Inter-Agency Urban Habitat Working Group (comprising urban specialists from, the Countryside Council for Wales, English Nature, the Environment and Heritage Service in Northern Ireland, Scottish Natural Heritage and the Joint Nature Conservation Committee) broadly endorsed these recommendations. In addition the Urban Group of the England Biodiversity Strategy has recommended that a new Priority Habitat of "Post industrial land of high ecological value" should be included as part of the current review of the UK BAP and this is being undertaken by the JNCC.

The Commission should welcome and support this initiative.

6.3 Strategies for conserving urban biodiversity in planning.

Conservation of biodiversity in towns and cities throughout the UK has progressed significantly over the past 25 years. A series of strategies was first developed in the early 1980s by the Metropolitan Counties including London, Manchester, Merseyside, Tyne

and Weir and the West Midlands. Other cities quickly followed with local authorities and urban wildlife groups taking the lead to develop major programmes in Bristol, Edinburgh, Leicester, and Sheffield. Most towns and cities now have policies for the protection of urban wildlife sites, which is achieved largely through the designation of Sites of Importance for Nature Conservation (SINCs) by local planning authorities. Some of these programmes have been remarkably successful in ensuring the protection of sites through the planning process despite the lack of a statutory basis for such sites.

The strategy for London, implemented by London Boroughs through the London Ecology Unit from 1986 to 2000, was particularly effective (see Appendix 1, and Goode, 2005) and now forms the basis of the Biodiversity Strategy for London, which is an integral part of the statutory London Plan (Mayor of London, 2002). Other cities adopted similar strategies, supported by specialist ecological teams as in Merseyside and Manchester (see Appendix 2), whilst others have developed arrangements with urban wildlife groups as in Bristol and Sheffield.

The most successful schemes are those which have been tied firmly into local government arrangements, through voluntary joint committees representing district planning authorities, as in the case of London and Manchester. These have developed clear strategies for protection of important sites through the planning process. To be effective and successful such schemes require the following:-

- A comprehensive inventory of habitats throughout the urban area.
- A system for evaluation of sites to determine their nature conservation importance based on criteria relevant to the urban context.
- Implementation through strategic planning and development control.
- Expert advice available to planners on the ecological implications of individual development proposals.
- Provision of expert ecological advice to support the local authority in the event of planning appeals.

Where this approach has been followed the implementation and protection of Sites of Importance for Nature Conservation (SINCS) has been more robust and effective than is generally the case where planning authorities depend on local wildlife trusts to provide the necessary ecological input. Although many towns and cities have developed urban nature conservation strategies there has been a variable degree of success and some of the possible reasons for failure are as follows

- Lack of legislative requirements for development of such strategies by local authorities.
- Failure to undertake comprehensive ecological surveys and to regularly update them.
- Inadequate long-term funding to maintain local biological records centres, particularly site-based information systems for use by local planning authorities
- Lack of an agreed methodology for comprehensive survey of open spaces within urban areas for nature conservation purposes.

- Lack of an agreed approach regarding appropriate criteria for conservation evaluation in urban areas, especially the criteria necessary to assess the social or educational value of sites.
- Absence of in-house ecological expertise to meet the needs of planning authorities, especially at district level.

Despite these problems it is clear that some urban local authorities have been particularly effective in implementing policies for biodiversity conservation and it is recommended that examples should be used as case studies to promote a wider application of such approaches. The statutory requirement in Greater London for a Biodiversity Action Plan, which forms part of the Mayor's overall strategic plan, provides an appropriate model not only for other major city regions, but also for smaller towns and cities as an integral part of their sustainable development.

6.4 Requirements for research

Evidence to the Commission suggests that there are several areas which would benefit from further research in order to develop more effective policies for the conservation of urban biodiversity. These include:-

- Clear definitions and classification of habitats of special urban character (particularly those of post industrial landscapes).

- Development of criteria for assessing the value of urban biodiversity, including social values and the importance of urban heritage components.

6.5 Legislation and Government Guidance

Current conservation legislation, at both EU and National level, caters poorly for the conservation of urban nature because it was not designed with this in mind. The Habitats Directive for example, defines priority areas for every other type of landscape except urban areas. Similarly the European Biodiversity Action Plan focuses solely on controlling the spread of urban areas to protect rural landscapes, and has little to say about the intrinsic worth of urban habitats. The recent EU Urban Thematic Strategy goes marginally further by recognising that integrated management of the urban environment should foster sustainable land-use policies that include promotion of urban biodiversity. Government guidance on biodiversity conservation in planning (PPS9) emphasises a hierarchy of importance of sites, giving highest priority to those of international and national importance. Whilst recognising that sites of regional or local value may be designated in strategic planning documents, the guidance suggests that a lower level of protection be given to such sites when considering planning issues.

PPS9 does, however, recognise that: "*networks of natural habitats provide a valuable resource. They can link sites of biodiversity importance and provide routes or stepping stones for dispersal of species in the wider environment*". The guidance states that "*Local authorities should aim to maintain networks by avoiding or repairing*

fragmentation and isolation of natural habitats through policies in plans Such networks should be protected from development and where possible strengthened by or integrated within it. This may be done as part of a wider strategy for the protection and extension of open space and access routes such as canals and rivers, including those in urban areas".

Whilst this guidance can be used by urban planning authorities to justify protection of the green infrastructure as part of biodiversity policies, there is a need for more broadly based policies specifically for urban areas which recognise the ecological functions provided by the Green Infrastructure.

Government guidance on planning for biodiversity (PPS9) does not adequately address the needs for biodiversity conservation in urban areas, either in terms of strategies for protection of important sites or in terms of the value of habitats for their ecosystem functions. It is suggested that this should be addressed as a major component of additional planning advice on the urban green infrastructure which should refer to examples of best practice, such as those in the TCPA Design Guide for Biodiversity (TCPA, 2004).

There is a particular policy issue concerning brownfield sites. PPS9 states that: "*the re-use of previously developed land for new development makes a major contribution to sustainable development by reducing the amount of countryside and undeveloped land that needs to be used. However, where such sites have significant biodiversity interest of recognised local importance, local planning authorities, together with developers, should aim to retain this interest or incorporate it into any development of the site*". This is an important policy which gives some protection to specialised urban habitats which are characteristic of brownfield land. Planning Policy Guidance on Housing (PPG3) also exempts 'natural' brownfield sites from development pressure, but it is unclear how planners are to assess the quality of such sites in the absence of national guidance. Such guidance needs to refer to both the social and ecological importance of such areas.

There is an urgent need for agreed criteria for assessment of such sites and for a well-defined set of habitats to be recognised in this context. The Commission should press for the definition of such habitats as part of the UK Biodiversity Strategy, and encourage the development of criteria for their evaluation.

The value of open space for nature conservation is recognised in Planning Policy Guidance 17, Open Space, Sport and Recreation. Biodiversity features in CABE Space's manifesto for open space and in its good practice guide for producing open space strategies. Despite this guidance, much urban greenspace remains of negligible biodiversity value, falling far short of its potential. This is partly due to the depletion of skills and resources in wider greenspace management, but stems more particularly from a lack of understanding among many greenspace managers of the opportunities and potential of greenspace for biodiversity. CABE Space is currently working with English Nature with support from Defra to produce a guide for managing greenspace more effectively for biodiversity. This should be welcomed.

The value of urban greenspace and biodiversity for health and wellbeing needs to be given greater prominence in guidance for urban planning and design. The work of Greenspace Scotland is particularly relevant and should be welcomed.

London is at present the only city required by law to produce a biodiversity action plan as part of strategic planning (GLA Act 1999). Whilst local authorities are encouraged to produce a biodiversity action plan as part of their Community Strategy this has not proved to be a significant factor in furthering the biodiversity work of local authorities. However, local authorities will shortly be required as public bodies to have regard to biodiversity conservation under new legislation (NERC Act 2006). All public bodies in Scotland, including local authorities, already have a duty to further biodiversity conservation under the Nature Conservation (Scotland) Act 2004.

It is argued in section 6.3 that one of the factors which has prevented effective strategies and programmes from being developed by local authorities is the lack of a specific duty with regard to biodiversity. Where such a duty does now exist in the case of London the result has been to ensure that biodiversity conservation is integrated fully in the spatial development plan for the capital (see Appendix 1). This has enabled London to implement regional policies which fully reflect the ecological and social values of biodiversity, and which also take into account the broader functional benefits of the green infrastructure. The effectiveness of this model, and the advantages gained, have been clearly demonstrated in the way that biodiversity is implemented in the statutory London Plan (2004) and in the way that it contributes to policies for adaptation to climate change.

Building on the new duties for all local authorities with regard to biodiversity conservation it is suggested that the model developed in London (Appendix 1) could be used as the basis for guidance from Government for local authorities to develop effective strategies and programmes for the conservation of biodiversity in urban areas. The Commission should propose that such guidance be issued for local authorities, which would supplement existing guidance (PPS 9) to cater more specifically for urban areas, and to give greater weight to the ecological services provided by biodiversity.

In view of the lead role which Local Authorities have in urban nature conservation one of the key issues is the need for biodiversity indicators to be included in Comprehensive Performance Assessment. In implementing the England Biodiversity Strategy, one of the key deliverables listed by DEFRA is that appropriate biodiversity indicators should be adopted in local and regional strategies, policies, plans and programmes, and that a biodiversity indicator is included in future Performance Assessment Frameworks of local authorities. The Commission should welcome and support these proposals.

7. Private Gardens

Introduction

In most towns and cities private gardens represent a significant proportion of the total area. For example in Greater London gardens make up almost a fifth (19.7%) of the total area of land. In addition to enhancing visual amenity, such gardens have important environmental functions. They provide areas of permeable soil where rainwater can infiltrate into the ground rather than flowing into the urban drainage system. They have a significant role in providing a wide range of habitats for urban biodiversity and they also provide local climatic amelioration within the urban fabric. Two current trends are reducing the total extent of private gardens. One is the result of individual householders converting their front gardens into paved areas to provide car parking space. The second is the widespread trend for new housing to be developed on land which was previously domestic gardens. This takes two forms. Where older properties are demolished for new high-density developments these may extend over the whole area of the property including former gardens since these fall under the definition of brownfield land. A second category forms so-called "backland development" or "infill" where sections of extensive back gardens are converted to housing.

Loss of front gardens

The environmental importance of London's front gardens was recently the subject of a report by the London Assembly (2005). It was estimated that conversion of London's front gardens to some form of hard standing has amounted to a total area of 32 km^2 (equivalent to 22 times the area of Hyde Park). The Royal Horticultural Society has also recognised the problems associated with loss of front gardens nationally and has issued guidance on the issue. Both these reports emphasise the loss of local amenity, impacts on drainage and reduction in biodiversity.

The main impact in terms of environmental sustainability is the reduced area for infiltration and consequent increase in storm water flows. As the trend for converting front gardens to hard surfaces continues it is likely to further exacerbate problems of localised flooding. The problem could be significantly reduced if the use of permeable surfaces was made mandatory. Such surfaces are readily available for use in SUDS schemes and it is suggested that a requirement for use of such surfaces be included in future planning guidance. The impact on biodiversity is less clear, but loss of hedges is likely to affect bird populations, and may have contributed to the decline in house sparrow populations. Loss of hedges, trees and shrubs from the urban streetscape also reduces the potential for local climatic amelioration, in terms of temperature and humidity, which is one of the ecological functions provided by front gardens. It is suggested that such features should be retained alongside provision for cars. The value of street trees and trees in front gardens in providing shade and reducing the impact of high summer temperatures is becoming more widely appreciated. This is, for example,

identified as an element of adaptation to climate change in current proposals for revision of the London Plan.

Recommendation:

It is recommended that planning guidance be amended to require permeable surfaces to be used for provision of car parking spaces in front gardens, and to encourage retention and enhancement of the green infrastructure wherever possible to maximise local climatic benefits and to provide for biodiversity.

Gardens as Brownfield development

There is a great deal of public concern regarding the character of new developments in situations where older properties are being removed to make way for new high density housing. A Private Members Bill was recently introduced with the aim of removing private gardens from the definition of brownfield development (Hansard 2006). Whilst a large part of the concern centres on the changing character and loss of visual amenity in the areas affected, this bill emphasised the problems of environmental sustainability resulting from the loss of green space involved. In response to questions the Government stated that no figures are available regarding the proportion of recently developed brownfield land which was private gardens.

High density housing development on garden land has clear environmental impacts in terms of visual amenity, biodiversity and loss of ecosystem functions, and these need to be balanced against the potential benefits of increased urban density. The impact on biodiversity can be serious as larger and longer-established gardens frequently contain elements akin to semi-natural landscapes, which can support important wildlife resources. Studies of bird populations in an outer London borough (Dawson *et al* 1990) showed that low density residential areas with large gardens were significantly more diverse than areas of medium to high density. The total number of species was substantially higher in areas with long gardens where belts of trees and scrub supported birds of woodland edge communities. Many of these species declined substantially in areas of medium density and were not present at all in high density housing areas. The London Borough of Sutton used this evidence to support its local plan policies for control of backland development and to justify its policies for protection of biodiversity. The choice of birds as an indicator is appropriate since they are a particularly visible element of urban biodiversity and provide residents with immediate daily contact with wildlife in their gardens. More recent studies of invertebrate populations shows that small gardens can have high levels of species diversity, but this does not apply to birds.

In the case of garden land there are problems in applying Government guidance on brownfield development (in PPS 9) which states that "*where such sites have significant biodiversity interest of recognised local importance, local planning authorities, together with developers, should aim to retain this interest or incorporate it into any development of the site*". The difficulty is that private gardens are not generally included in locally designated SINCs, so planners may take the view that gardens do not have significant

biodiversity interest unless protected species are involved. In reality many large gardens have significant local value for biodiversity, especially the more extensive landscapes with long-established trees. However, there is no generally accepted system for evaluation of this biodiversity. Planning guidance is required to ensure that local authorities and developers are fully aware of the potential biodiversity value of such areas and to promote effective measures for its evaluation.

One of the difficulties regarding new housing schemes on gardens is the cumulative effect of a number of such developments, which together result in a substantial reduction in the amount of green space, particularly in suburban areas. This overall reduction in the green infrastructure will have implications for climatic amelioration and may also increase the risk of flooding. It is suggested that a density threshold set by local authorities for individual schemes could help to maintain the functional value of urban green space. Such an approach is particularly relevant to the need for adaptation measures in relation to climate change.

Recommendations

The Commission should recommend that Government guidance be produced requiring Local Authorities to set a density threshold for new housing developments on land which was previously private gardens (including backland development) in order to ensure that a sufficient proportion of greenspace is retained for ecological functions to be maintained.

The Commission should also recommend that Government guidance be provided, as part of advice on the green infrastructure, recognising the potential importance of garden land for local biodiversity and promoting effective measures for its evaluation in the context of new development proposals.

8. Health and wellbeing

Importance of green space for health

There are 27,000 urban parks covering 14% of our towns and cities in the UK, totalling 143,000 ha. For many people without transport they represent the only contact with green space. It is estimated that some 33 million people make over 2.5 billion visits each year to urban green space in England (Dunnet, 2002). A Mori poll in 2004 showed that 74% of adults agreed that being able to use a local park or public open space was important for their general health. Almost half (49%) live within five minutes walk of a park of public open space.

"Many local authorities have adopted general statements about the benefits of urban greenspace. Good quality greenspace encourages people to walk, run, cycle and play, as well as improving air quality and reducing noise. If paths and cycle networks are integrated to facilitate commuting, they can reduce transport needs and provide safe and healthy routes to school for children that avoid hazardous road crossings. Recreational parks and green areas provide opportunities for healthy physical activity and the relief of stress. Furthermore the passive benefits for physical and mental health of an urban landscape with trees have been well documented. Enjoyment of green areas may help people to relax or may give them fresh energy" (Douglas, 2002). Such findings broadly confirm the conclusions of others concerning contact with nature, reduction of stress and escape from the dense urban scene (Nicholson-Lord, 1987, Kaplan and Kaplan, 1989, Pretty, 2003). In examining the importance of nature in environmental perceptions and stress recovery Henwood (2002) is clear that " the evidence is already extensive on how contact with and appreciation of nature can contribute to people's wellbeing and health".

One of the best known, and most frequently quoted, is work done by Ulrich. In this study he compared hospital patients with views of nature and those with views of other buildings. Patients viewing nature recovered from gall bladder surgery more quickly, required less pain relief or other anxiety medication, and also showed fewer complications and fewer reported complaints in nurses notes (Ulrich, 1984). In another study he compared the stress levels of car drivers in natural surroundings with those of drivers stuck in traffic in densely built up areas. Those who could view nature exhibited lower levels of stress (Ulrich, 1981). Similarly Moore (1981) compared prisoners and found that those with views of nature had fewer sickness episodes.

In Japan Takano *et al* showed that residents of Tokyo with access to nearby nature demonstrated increased longevity, higher levels of physical activity, and better general health. In the Netherlands de Vries *et al* (2003) examined the effect of nearby nature on residents, and found that children (of less than 16), housewives, and people older than 65 were observed to spend more time outside being active. They also found that the physical and mental health of people living near green spaces was better than for those with little or no access.

Maller *et el* (2005) state that empirical, theoretical and anecdotal evidence demonstrate that contact with nature positively impacts on blood pressure, cholesterol, outlook on life and stress reduction. These outcomes have particular relevance to areas of mental health and cardiovascular disease. "Whilst the extent to which contact with nature can contribute to human health and wellbeing is in need of further investigation, the strength of this evidence alone is sufficient to warrant inclusion of contact with nature within population health strategies, and for parks to be considered a fundamental health resource in disease prevention for urban populations worldwide".

Douglas (2005) has reviewed scientific evidence (from controlled experiments, tests using slides and videos, and attitudinal surveys) regarding the impact of natural areas on mental health and wellbeing. These demonstrate clear evidence that among many sectors of society there are positive benefits to be gained from both active and passive involvement with natural areas in towns and cities. Regular access to restorative, natural environments can halt or slow processes that negatively affect mental and physical health. "There is good scientific evidence that contact with nature in urban areas can improve mental health and can help in the restoration of psychological wellbeing. The evidence is strong enough to make the case for the inclusion of areas of natural vegetation in both urban planning, particularly for the expansion of existing towns and in the creation of new urban settlements".

Value of greenspace for physical activity

In 2004 Bird produced a report aimed at answering the question - can green space and biodiversity increase levels of physical activity? Physical inactivity is a major preventable health risk, which affects about 60% of the population, and correcting this is a major public health priority. For children, inactivity is helping to create a future generation who are more likely to become inactive and obese adults. The cost to the economy is calculated to be £8.2 billion. There is growing recognition that natural green space can increase levels of physical activity. A better understanding of the relationship between exercise and open space will help the Government reach targets to increase levels of physical activity, as well as provide a significant economic reason to maintain green space. To increase physical activity levels in a green space, the space should be accessible (within 2km of home), have a good surface with no obstructions such as stiles, but above all it should feel safe (Bird, 2004).

Moderate exercise includes walking, cycling, swimming, gardening horse-riding and conservation work. This level of activity is enough to raise the pulse to over 60% of the maximum heart rate, which is the threshold to improve cardiovascular health. Free access to good quality parks and greenspace enables people to take the necessary exercise; 30 minutes a day of moderate exercise can significantly reduce the risk of strokes and coronary heart disease. The value of moderate exercise and in particular walking should be promoted to the public as many people still believe that health improving exercise means the gym. All greenspace should aim to fulfil people's physical activity needs. This should become a success criterion alongside environmental and

educational objectives (Bird, 2004). However, the need for biodiversity as part of this provision was not proven.

The Green Gym run by the BTCV has developed over 50 examples of schemes which provide rather more than the minimum for health, but also show a distinct swing in the direction of developing a relationship with nature. In one case 50% of members felt that being in the countryside was a very important factor at the beginning of the scheme, but after six months this increased to 75%. In contrast keeping fit was very important in 100% of members at the start, but fell to 45% after six months. Whilst most people joined the scheme because of the need to keep fit, it appears that 'being in the countryside' became a more important motivating factor. Organisers of the Green Gym schemes throughout the UK have noted this trend of people entering for health reasons, but continuing through developing a relationship with nature (Bird, 2004, Reynolds, 2002).

There is growing concern about the health of children and young people. A variety of research has found that 20% of 4 year olds, 8.5% of 6 year olds and 15% of 15 year olds are obese. Linked to ever more sedentary lifestyles and reduction in outdoor activity, this is particularly significant when evidence shows that adult patterns of exercise are set early on in life. Provision of open space for children is a key element, yet this is frequently overlooked despite the fact that the health benefits to children are significant. Places close to home are vital, and the value of nature in such places is particularly important. The range of conditions of value to children was described by Johnston (1990), and the benefits to be gained were described by Mostyn (1979) and Millward and Mostyn (1989).

Access to nature

English Nature has encouraged the development of standards for accessible natural green space in towns and cities (Box *et al*, 1993, Harrison *et al* 1995, Handley, 2003) which placed considerable emphasis on the values to be gained from such areas in terms of health and wellbeing. Although use of open space standards by local authorities was found to be widespread, such standards focused almost exclusively on the provision of sport and recreation facilities to the exclusion of natural greenspace. The London strategy (described in Section 6 and Appendix 1) is the one example where Areas of Deficiency have been mapped and are now actually used by local authorities. It is clear that there is a need for local authorities to use such an approach more widely.

Green space provides safe, local and accessible opportunities for physical activity and has a positive impact on mental health and wellbeing. The closer an area of green space is to home, the more valuable it is for children. The connectivity of green space is an important element in providing for many of the health related benefits of green space, especially through walking and cycling. The TCPA guide (2004) highlights the importance of retaining and enhancing existing natural features, and maintaining local distinctiveness as part of the approach.

Greenspace Scotland (2004) has made strong links between the value of green space for health and the wider issues of environmental planning. Cabe Space (2004) similarly emphasises the health value of green space in its analysis of how high quality parks and public spaces create economic, social and environmental value.

Recommendations

The Commission should urge Government to recognise the health benefits of green space in planning.

Planning guidance on the green infrastructure should be provided, including details of these health benefits, which provide details of the way in which such benefits can be delivered at all levels within urban areas.

9 Recommendations for Policy Guidance

The individual sections of this report contain recommendations pertinent to those sections. The purpose of this section is to provide an overview of the need for new guidance in relation to the green infrastructure.

It is suggested that new Government guidance be produced to emphasise the benefits of the green infrastructure, particularly in terms of the ecological services which it provides, and to demonstrate best practice for urban design and planning. What I am proposing is guidance which addresses all the elements of this report, in a way which brings them together for the first time. The section on multifunctional greenspace provides the key, in that it provides the basis on which other sections can contribute. Climate, water management, biodiversity and health; each has a part to play in this process in terms of ecological services. At present these ecological services are not dealt with adequately, or at all, in the planning process. Where they are, the linkages are frequently not clear. What is needed is integrated guidance, drawing on the full range of issues covered in this report, and bringing some, like the health benefits of urban green space, up the agenda for action for the first time.

The approach that is needed is to have cross-cutting guidance, based firmly on the multi-functional green space network, and ensuring that it provides the necessary advice for sustainability. Guidance on the functions of the green infrastructure should include a range of topics which are not currently addressed within planning guidance, such as health, together with others which are not dealt with fully. For instance in the case of biodiversity there is a need for guidance to be extended to include these functions. Similarly in the case of sustainable urban drainage systems, guidance needs to include all aspects of these systems. At other levels there are clear links between green roofs, SUDS and biodiversity which demonstrate the need for integrated guidance.

There is also the effect of climatic amelioration of greenspace and its effects on the urban scene, which is likely to become a major issue in relation to climate change. Understanding the environmental functions of the green infrastructure is particularly relevant to assessing climate change impacts in urban areas and developing adaptation strategies. There are advantages to be gained from maintenance of an effective green space network, which can help to ameliorate some of these effects.

But it is not only in relation to climate change that planning guidance is needed. Good practice guidance on the green infrastructure is needed now if we are to achieve sustainability and it requires a holistic approach for this to be achieved. The issues raised in this report are fundamental to sustainable development.

10. References

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11. Appendices

Appendix 1.

Case Study: London Biodiversity Strategy

Introduction

Over the past twenty years an innovative programme for nature conservation has been developed and implemented in London. Its purpose is to protect and enhance London's natural areas and their associated species, and to make it possible for Londoners to have greater contact with nature in their everyday lives. The programme has involved many different players including official agencies especially the London Boroughs, and voluntary bodies such as the London Wildlife Trust, often strongly supported by public opinion, particularly at the local level. New approaches with a strong social dimension, that were at first seen as a radical departure from traditional nature conservation, have since been adopted as an integral part of city management. The overall programme has now been adopted by the Mayor of London as the basis for his Biodiversity Strategy which forms part of the statutory London Plan.

Identifying Important Sites

When the Greater London Council took the first steps in developing a nature conservation strategy in 1984 knowledge of London's ecology was patchy and incomplete. The first priority, therefore, was to undertake a comprehensive survey of wildlife habitats. The strategy required detailed ecological information for all places of potential significance, including information on the kinds of habitat and an assessment of their importance. Priority was given to areas of open land of potential significance for nature conservation. Formal parks and cemeteries, private gardens, playing fields and open areas with little wildlife interest, such as arable land, were all excluded from the survey. An initial desk study using air photography resulted in over 1,800 "sites" being selected for survey, totalling about 20% of the land area of Greater London. For each site information was collected on the types of habitat and dominant species, overall richness of plant species, presence of rare or unusual species, current land-use and accessibility.

This survey provided the starting point for selection of Sites of Importance for Nature Conservation in London. A standardised set of criteria was used for comparing and evaluating sites. Although many of these criteria are similar to those developed by UK government agencies for selecting sites of national importance, (such as species richness, size and presence of rare species) there are some essential differences. Public access and value for environmental education are examples.

The data have since been periodically updated through more detailed surveys of each individual London borough. Since 2000 the GLA has implemented a rolling programme of resurvey covering about 3 boroughs each year, with the intention that all 33 will be covered within ten years. Over the past twenty years the database has provided a vital tool in strategic planning and for advising on the ecological implications of proposed new developments. Probably the most detailed ecological database of any part of the UK, it

now provides essential information for implementation of the Mayor's biodiversity strategy for the capital.

The procedure for selecting sites for protection was first described in *Ecology Handbook 3, Nature Conservation Guidelines for London (GLC,* 1985). This contained a series of ecological policies for use in strategic planning in London and set out the rationale to be used for deciding which areas are important for nature conservation. It provided the basis for the system used by the London Ecology Unit from 1986-2000. Although some changes have occurred in the detailed approach, the rationale remains much the same as that developed in 1985 and it has been widely accepted as the basis for nature conservation planning in London. Although at that time non-statutory it was endorsed by the London Planning Advisory Committee for use in Unitary Development Plans for all London boroughs in 1995. The same policy, criteria and procedures for identifying nature conservation sites were adopted by the Mayor of London in 2000, and are set out in full in his Biodiversity Strategy (2002).

Categories of protected sites

The strategy is based on a hierarchy of sites at three levels London, Borough and Local. Those of London-wide strategic significance are called Sites of Metropolitan Importance for Nature Conservation. They include nationally protected sites, such as National Nature Reserves and Sites of Special Scientific Interest, together with many other sites which together represent the full range of habitats in London. The second category comprises sites of significance to individual London Boroughs, and a third category of Local Sites are those important at neighbourhood level.

The use of these three different levels of importance is an attempt not only to protect the best sites in London but also to provide each area of London with accessible wildlife sites so that people are able to have access to nature within their local neighbourhood. This hierarchy means that sites of London-wide importance are chosen in the context of the geographical area of Greater London. Sites of borough importance are chosen from the range of sites in each individual borough. Sites of local importance are those which are valued by local residents, schools or community groups at the neighbourhood level.

At the London-wide level about 140 Sites of Metropolitan Importance are identified. They are distributed throughout London and vary in size from only a few hectares to over 1,000 hectares. Most (90 sites) are less than 100 ha., of which 55 are less than 50 ha. A few Sites of Metropolitan Importance have been lost to development since the list was first endorsed by the London Ecology Committee in 1988. Most of these were wasteland sites which were already scheduled for development. Additional sites have been added to the list over the years as individual boroughs have been surveyed in greater detail. The list of Metropolitan Sites was endorsed by the Mayor in 2002 and these sites are given statutory protection by policies in his statutory London Plan (2004) which now provides the strategic planning framework for London.

As a result of the detailed surveys for individual boroughs the overall strategy for London identifies over 1,500 sites, which are designated as being of importance for biodiversity conservation in Borough Plans. This total includes all three categories of protection i.e. Metropolitan, Borough and Local. A significant number of sites designated through this process are also protected as Statutory Local Nature Reserves (LNRs). This is a

designation made by the boroughs to give a greater degree of protection in the long term and to promote greater public access. A total of 105 areas are now designated by London Boroughs as LNRs, compared with only two in 1980.

Areas of deficiency

Those parts of London which do not have good access to high quality wildlife sites are identified as Areas of Deficiency in access to nature. These are defined as built-up areas more than one kilometre from an accessible Metropolitan or Borough Site. Detailed maps defining such areas of deficiency have been produced for virtually all London boroughs. These maps assist boroughs in identifying priority areas for provision of new habitats and aid the choice of Sites of Local Importance. Local Sites are chosen as the best available to alleviate this deficiency. Such sites need not lie in the area of deficiency, but should be as near to it as possible. Where no such sites are available, opportunities should be taken to provide them by habitat enhancement or creation, by acquisition of land capable of fulfilling this function, or by negotiating access and management agreements and improving access routes in the surrounding urban area**.**

Implementing the strategy through strategic planning

The Mayor's Biodiversity Strategy published in 2002 includes specific policies and proposals to protect and enhance biodiversity through strategic planning. These policies are also contained in the statutory London Plan (2004). Protection of Sites of Importance for Nature Conservation is covered by two major proposals, as follows:-

- Proposal 1. The Mayor will identify Sites of Metropolitan Importance for Nature Conservation. Boroughs should give strong protection to these sites in their Unitary Development Plans. The Metropolitan Sites include all sites of national or international importance for biodiversity.
- Proposal 2. Boroughs should use the procedures adopted by the Mayor to identify and protect Sites of Borough and Local Importance for Nature Conservation. The Mayor will assist and advise them in this.

The effect of these proposals is that the hierarchy of designations in London is now subject to statutory planning procedures. But it goes further than that since the Biodiversity Strategy states that the Mayor will measure the success of his strategy primarily against two targets, to ensure firstly, that there is no net loss of Sites of Importance for Nature Conservation, and secondly that the Areas of Deficiency in accessible wildlife sites are reduced. Monitoring of these targets is addressed in the *Mayor's State of the Environment Report* (Mayor of London, 2003).

Implementation of the Mayor's policies to reduce such areas of deficiency is achieved through individual London boroughs as planning authorities. Areas of Deficiency are identified in the five Sub-regional Frameworks which form part of the overall London Plan. Individual Boroughs are asked to identify areas of deficiency in access to nature and to address these in their Local Development Frameworks through three processes:-

i The natural value of an accessible site is improved, so that a place that previously did not provide significant experience of nature comes to do so.
ii New access points are provided to sites which already provide a significant experience of nature.
iii Improvements are made to walking access through the areas surrounding a site, bringing more parts of developed London into the one kilometre walking distance.

Appendix 2

GREATER MANCHESTER ECOLOGY UNIT
CORE SERVICES TO DISTRICTS

1 To maintain a wildlife database on behalf of the districts, particularly the Register of Sites of Biological Importance. Service to include inspection of every SBI on average every 5 years, survey and assessment of potential new SBIs, production of annual SBI review and supply of digitised SBI boundaries for use with GIS.

2 To advise on planning applications and development proposals on ecological matters, especially those affecting statutory sites, SBIs, protected and priority habitats and wildlife corridors.

3 To provide advice and information relating to national and international wildlife legislation and planning guidance.

4 To provide advice on species, habitat management and habitat creation.

5 To advise on Unitary Development Plan reviews in relation to ecological matters, including environmental appraisal and to contribute to the preparation of supplementary planning guidance as appropriate.

6 To advise on the preparation of nature conservation and other strategies.

7 To coordinate the preparation and implementation of the Greater Manchester Biodiversity Action Plan in conjunction with key partners and to assist in the preparation of district BAPs.

8 To liaise with statutory agencies and the voluntary sector, including chairing and servicing the Greater Manchester Wildlife Working Group and attending meetings of district Wildlife Advisory groups, Environment Forums etc.

9 To represent the greater Manchester Authorities at regional and national level on ecological and ecology related issues and to contribute to initiatives at county level as appropriate.

10 To provide training to local authority officers on ecological matters and nature conservation issues through the Greater Manchester planners Training Group and/or other organisations.